

What is claimed is:

- 1        1. A high-efficiency liquid oxygen (LOX) storage/delivery system, comprising:
  - 2            a portable LOX/delivery apparatus comprising a portable LOX container, and including a portable-unit LOX transfer connector connected to the portable LOX container and connectable to a main source of LOX in a primary reservoir LOX container for transferring LOX to said portable container; a portable-unit oxygen gas transfer connector for transferring oxygen gas from said portable LOX container to an oxygen gas delivery device for delivering oxygen gas to a patient; an inter-unit oxygen gas transfer connector for connecting the portable apparatus to a stationary source of oxygen gas in said primary reservoir container for transferring oxygen gas to said portable container;
  - 15            wherein, when the inter-unit oxygen gas transfer connector of the portable container is connected to said stationary source of oxygen in said primary reservoir container, oxygen gas can be transferred to the oxygen gas delivery device for delivery to the patient from the stationary source of gas in the primary reservoir LOX container through the inter-unit oxygen gas transfer connector.

- 1        2. The system of claim 1, wherein the inter-unit oxygen gas transfer connector is configured such that, when the

3       inter-unit oxygen gas transfer connector of the portable  
4       container is connected to said stationary source of oxygen in  
5       said primary reservoir container, oxygen gas can be  
6       transferred to the oxygen gas delivery device for delivery to  
7       the patient from the portable LOX container and gaseous oxygen  
8       is permitted to be transferred to the oxygen gas delivery  
9       device from the stationary source of gas in the primary  
10      reservoir LOX container.

1           3. The system of claim 2, further comprising:  
2            a primary reservoir LOX storage/delivery apparatus  
3       comprising said primary reservoir LOX container;  
4            the primary reservoir LOX apparatus including a main LOX  
5       transfer connector connected to the primary reservoir LOX  
6       container for inputting LOX into said primary reservoir LOX  
7       container and connectable to the portable-unit LOX transfer  
8       connector for outputting LOX from said primary reservoir LOX  
9       container to said portable LOX container;  
10          a main-unit oxygen gas transfer connector for  
11       transferring oxygen gas from said primary reservoir LOX  
12       container, the main-unit oxygen gas transfer connector being  
13       connectable to said inter-unit oxygen gas transfer connector,  
14       for said transfer of said oxygen gas from said stationary  
15       source of oxygen to said portable apparatus wherein said  
16       gaseous oxygen is permitted to be transferred to the oxygen  
17       gas delivery device from said stationary source of oxygen.

1           4. The system of claim 3, further comprising:

2           a portable-unit primary relief valve connected to the  
3        portable LOX container for venting oxygen gas out of said  
4        portable LOX container when pressure in said portable LOX  
5        container reaches a predetermined level for said portable LOX  
6        container; and

7           a main-unit primary relief valve connected to the primary  
8        reservoir LOX container for venting oxygen gas out of said  
9        primary reservoir LOX container when pressure of oxygen gas in  
10      said primary reservoir LOX container reaches a predetermined  
11      level.

1           5. The system of claim 3, further comprising a primary  
2        indicator device connected to the primary reservoir LOX  
3        container for indicating the LOX contents of the primary  
4        reservoir LOX container.

1           6. The system of claim 3, wherein said system is adapted  
2        for functioning within an operating cycle in which oxygen gas  
3        is withdrawn from the primary reservoir container for a  
4        withdrawal period of at least about 5 hours per day, then said  
5        portable LOX apparatus is filled with LOX from said primary  
6        reservoir LOX apparatus, whereby oxygen gas pressure in said  
7        primary reservoir LOX apparatus is reduced to a level such  
8        that pressure may increase within said primary reservoir

9       container for a gas pressurizing period of about 5-15 hours  
10      per day without LOX or oxygen gas being withdrawn from said  
11      primary reservoir container and without oxygen gas being  
12      vented from said primary reservoir container during said gas  
13      pressurizing period.

1           7. The system of claim 6, wherein said system is adapted  
2      for functioning within an operating cycle in which, during  
3      said withdrawal period, the inter-unit oxygen gas transfer  
4      connector of said portable LOX apparatus is connected to said  
5      main-unit oxygen transfer connector of said primary reservoir  
6      container so that oxygen gas can be transferred from the  
7      portable container to the oxygen gas delivery device while  
8      oxygen gas is transferred to the portable apparatus from the  
9      primary reservoir container through the first oxygen transfer  
10     connector.

1           8. The system of claim 5, wherein said system is adapted  
2      for functioning within an operating cycle in which said  
3      withdrawal period is at least about 10 hours per day.

1           9. The system of claim 3, wherein said oxygen gas  
2      delivery device is connectable to said main-unit oxygen gas  
3      transfer connector for transferring oxygen gas from said  
4      primary reservoir LOX container for delivery to said patient.

1           10. The system of claim 9, wherein a flexible gas  
2       conduit is connectable between the main-unit oxygen gas  
3       transfer connector to said oxygen gas delivery device.

1           11. The system of claim 3, wherein a flexible gas  
2       conduit is capable of connecting the main-unit oxygen gas  
3       transfer connector to the inter-unit oxygen gas transfer  
4       connector for transferring oxygen gas from said primary  
5       reservoir container to said portable apparatus.

1           12. The system of claim 3, wherein said oxygen gas  
2       delivery device is connected to a gas conserving device, so  
3       that when said patient exhales, oxygen gas accumulates in said  
4       conserving device, and when said patient inhales, oxygen gas  
5       is delivered to said patient from said conserving device.

1           13. The system of claim 3, wherein said primary  
2       reservoir LOX apparatus further includes a pressure indicator  
3       device for indicating an internal gaseous oxygen pressure  
4       within said primary reservoir LOX container.

1           14. A method for utilizing a high-efficiency liquid  
2       oxygen (LOX) storage/delivery system as in claim 3, said  
3       method comprising connecting said inter-unit oxygen gas  
4       transfer connector of said portable container to said main-  
5       unit oxygen transfer connector of said primary reservoir

6       container, and withdrawing oxygen gas from said portable  
7       container through said portable-unit oxygen gas transfer  
8       connector while oxygen gas is transferred to the portable  
9       container from the primary reservoir container through the  
10      main-unit oxygen transfer connector.

1       15. The method of claim 14, further comprising the steps  
2       of withdrawing oxygen gas from the primary reservoir container  
3       for a withdrawal period of at least about 5 hours per day,  
4       then filling said portable LOX apparatus with LOX from said  
5       primary reservoir LOX apparatus through said portable-unit LOX  
6       transfer connector connected to said main-unit LOX transfer  
7       connector, disconnecting said portable LOX apparatus from said  
8       primary reservoir LOX apparatus, and withdrawing oxygen gas  
9       from said portable LOX apparatus, whereby during said  
10      withdrawal period, oxygen gas pressure in said primary  
11      reservoir LOX apparatus is reduced to a level such that  
12      thereafter, pressure may increase within said primary  
13      reservoir container for a gas pressurizing period of about 5-  
14      15 hours per day without LOX or oxygen gas being withdrawn  
15      from said primary reservoir container and without oxygen gas  
16      being vented from said primary reservoir container during said  
17      gas pressurizing period.

1       16. The method of claim 14, wherein prior to complete  
2       withdrawal of oxygen gas from said portable LOX container  
3       while said portable LOX container is partially filled with

4       LOX, the inter-unit oxygen gas transfer connector of said  
5       portable LOX container is connected to said main-unit oxygen  
6       transfer connector of said primary reservoir LOX container,  
7       and oxygen gas is withdrawn from the portable LOX container  
8       while oxygen gas is transferred to the portable LOX apparatus  
9       from the primary reservoir LOX container through the main-unit  
10      oxygen transfer connector.

1       17. The method of claim 17, wherein during said  
2       withdrawal period, said inter-unit oxygen gas transfer  
3       connector of said portable LOX container is connected to said  
4       main-unit oxygen transfer connector of said primary reservoir  
5       LOX container, and oxygen gas is transferred from the portable  
6       container to the oxygen gas delivery device while oxygen gas  
7       is transferred to the portable LOX apparatus from the primary  
8       reservoir LOX container through the main-unit oxygen transfer  
9       connector.

1       18. The method of claim 17, wherein during said  
2       withdrawal period, the inter-unit oxygen gas transfer  
3       connector is connected to the main-unit oxygen gas transfer  
4       connector by a flexible gas conduit.

1       19. The method of claim 14, wherein during said  
2       withdrawal period, the main-unit oxygen gas transfer connector  
3       is connected to said oxygen gas delivery device by a flexible  
4       gas conduit.

1           20. The method of claim 14, wherein said oxygen gas  
2 delivery device is connected to a gas conserving device, so  
3 that when said patient exhales, oxygen gas accumulates in said  
4 conserving device, and when said patient inhales, oxygen gas  
5 is delivered to said patient from said conserving device.